Demographic Constraints on the Formation of Traditional Balkan Households

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Households and Their Determinants

One of the most intriguing of historical records is the household census, giving us as it does an insight into the conditions of life of the common people in that institution that is the harbor of intimacy and the wellspring of our differences. Yet, investigation of the household is fraught with difficulty. We cannot be sure what the historical census taker meant when calling units by the term "house," when the units are not named as households but merely listed, or if separation of the units in the census list is ambiguous.[1] Understanding is sharpened when the kinship relationship between included individuals and the presumed head of household is given. But even here we find difficulties when kinship relationships are given not only between persons and the heads of their households but between heads of households within a settlement, for then it is not clear whether two apparent heads are heads of separate households or of subunits within a household. We are also puzzled by omission or underreporting of females or the young, and by the failure to specify marital status. I have shown, for example, in an analysis of the chrysobull of Chilandar[2] that underreporting of women can be very severe, and in an analysis of the chrysobull of Dečani[3] that plausible changes in interpretive assumptions about household boundaries and the marital status of males result in large differences in the estimated frequencies of complex households.

Further, the listings of households left to us by the accidents of the past are at best almost always snapshots in time, pictures of the constitution of social units at an instant. Such is the nature of any census; it is a slice of a process. There are exceptions. Some *stati animarum* from later periods of Balkan history are running records of births, marriages, and deaths for each household—the priest's own continuous family reconstitution—and of course wherever parish records are accompanied by good information on the location of individuals, for example, household number, such running reconstitutions of social units can be constructed. Thus you can make your own successive slices and study the household as an unfolding process.

This unfolding process, with its instantaneous realization in a census, has two determinants. One is the universe of persons from which the members of households are drawn. The second is the set of cultural norms, followed more or less, according to which people are taken into and released from households. Without putting too fine a point on it, I note the rather stubborn consistency with which the peoples of the world have placed primary emphasis on genealogical linkages in defining ordinary eligibility for household membership. The universe of persons from which members of households are drawn is itself defined by cultural rules, of course. In most societies that universe of persons is usually a subset of the genealogical network, and deviations from that pattern are regarded as exceptions to the norm. Witness in our own society, in which kinship is less salient as an

[1] The ambiguity of the household, as a theoretical concept and as a practical tool in social analysis, is severe. See, e.g., E. A. Hammel, "On the *** of Investigating Household Form and Function," in *Households: Comparative and Historical Studies of the Domestic Group,* ed. R. M. Netting, R. R. Wilk, E. J. Arnould (Berkeley, 1984), 29–43, and the introduction to that volume, as well as other papers therein.

[2] "Household Structure in Fourteenth Century Macedonia," *Journal of Family History* 5 (1980), 242–73.

[3] "Sensitivity Analysis of Household Structure in Mediaeval Serbian Censuses," *Historical Methods* 13 (1980), 105–18.

organizing principle, the common view of households consisting of unmarried heterosexual couples, homosexual couples, sets of unmarried non-kin, communes, and the like, as somehow transient or unusual. Many persons with a genealogical connection are only rarely included in households, although the occasional second cousin thrice removed may be encountered. Some persons with no demonstrable connection may be included, but most household lists clearly identify them as boarders, lodgers, clients, or servants. Considering both determinants of household structure—the constitution of the recruitment pool, as it were, and the rules of recruitment from it—is a tall order, yet it is the results of these two processes that we see in historical household censuses and must seek to understand.

Intent of This Paper

In this paper I ask first how the formation of households might be affected by those underlying demographic processes (usually occurring in the household itself or between households) that produce the set of persons from which members commonly can be drawn. Here I mean the births, marriages, and deaths that are the grist of household formation. These are, of course, the fundamental events of demography. The remaining fundamental event of that part of our lives is migration. In the sense that migration means movement between communities, it is ignored in this paper. In the sense that migration means movement between households as a consequence of marriage, I include it as a set of ethnographically reasonable procedures for the making of marriages, the postmarital residence of couples, and other rules of household formation and dissolution.

Second, I permit these demographic events to play against a grid of cultural specifications of how households are formed and how they dissolve. Although these specifications are often difficult to elicit in the course of real, on-site ethnography, and although they must be arbitrarily imposed in an exercise such as this, when the time and location of the phenomena of interest provide us virtually no clues, I have attempted to ground the specifications as closely as possible in realistic ethnographic expectations.

Third, I examine the households that might have been formed by this play of demographic events against a cultural grid, classifying the households according to an arbitrary but nevertheless convenient and widely used scheme.[4] It is important to note that the use of household classification in this way fairly replicates what one would do with an historical household census. It does not attempt directly to assess the cycle of household development through stages of the classification.[5]

The Expected Structure of Balkan Households on the Fringe of Empire

My contribution to this volume is marginal in several senses. First, it is a theoretical exercise in the mathematical modeling of social relationships and is thus intrusive into a well-developed tradition of humanistic scholarship. Second, it uses very little direct evidence from the historical period, although it is strongly informed by A. Laiou's pioneering analysis.[6] Third, it is not about the core of Byzantium but about the interlopers and wild tribes on its northern frontier. I have used some evidence from the Theme of Strymon, which is itself not in the core, but even those phenomena are within the pale, on the Mediterranean side of the Slavic and Albanian tradition, more in the region of the olive and the vine, less in that of a more ancient pastoralism.[7]

We know from evidence of kinship terminologies such as that of early Latin that the Indo-European peoples originally placed heavy emphasis on agnatic connection, and indeed there are traces in Indo-European languages of what anthropologists call "Omaha" kinship terminology, a kind of segmentation of the genealogical network typically associated with strong patrilineal social organization.[8] Similarly, among the Balkan Slavs and Albanians, and the speakers of Indic languages on the Indian subcontinent, we find in the recent past and even today strong evidence of patrilineal organization and of patrilocal joint and ex-

[4] E. A. Hammel and Peter Laslett, "Comparing Household Structure over Time and between Cultures," *Comparative Studies in Society and History* 16 (1974), 73–109.

[5] See, e.g., the discussion in E. A. Hammel, "The Zadruga as Process," in *Household and Family in Past Time*, ed. Peter Laslett (Cambridge, 1972), 335–73; and E. A. Hammel and Joel M. Halpern, "Serbian Society in Karadjordje's Serbia," *University of Massachusetts Papers in Anthropology* 17 (1977), 1–36.

[6] Angeliki E. Laiou-Thomadakis, *Peasant Society in the Late Byzantine Empire: A Social and Demographic Study* (Princeton, 1977).

[7] Hammel, op. cit.

[8] For example, in such terminological systems a man's mother's brother and his mother's brother's son and his mother's father, all being males of the mother's patrilineage, are referred to by the same kinship term. The trace of this in the Latin terminology is the close similarity of *avus* and *avunculus*, i.e., maternal uncle is "little grandfather."

tended family household organization.[9] Typically, such households may consist of a core of father with married sons, or married brothers, or either of these at broader and deeper range, so that some households might contain a grandfather, his married sons, and their married sons, plus wives and children. With the passage of time the grandfather might die and the young children might marry, so that the married agnatic core would consist of brothers, first cousins (the sons of brothers), and second cousins (the sons of first cousins). Households of over a hundred members are rare, but not unknown in the record. Such households are the classic *zadruga* of the Balkan Slavs, the *Hauskommunion* noted by their German observers. They are of course quite different from the households of the core cultural area of Byzantium itself—rather, they are part of the Slavic and Albanian fringe.

The Influence of Demographic Rates on Household Composition

Now further to the demography of this. It should be obvious that if the mortality of adults is severe, few grandfathers will live to see their grandsons marry; indeed, not so many fathers might live to see their sons marry, and the extension of household structure across generations will be consequently rare. Indeed, under modern conditions of greatly improved adult mortality, the *zadruga* in its generational extension may become more common than in the past.[10] It should also be obvious that birth rates and child survival must be sufficiently high to permit a sufficient number of sons to marry and co-reside. Indeed, in a very artificial and schematic population that we may imagine for hypothetical purposes, in order for every family to consist of a father and two married sons, every family would have to have four surviving children, two male and two female. Such a population would double in size in every generation, having a growth rate of about 2.5 percent per year. A village of 500 persons would increase to about 6,000 over a century. Such growth rates are extreme and seldom sustainable for long; we find them today only in countries where modern public health efforts have reduced mortality, but modern birth control has not been accepted. But such growth rates are imaginable for short periods of time. We must also consider that growth rates are not always positive; populations also decline in size, and in the historical past often because of crises of mortality. But under some given regime of mortality, low fertility can also lead to population decline. We do not expect to find historical populations with conscious long-term fertility control sufficient to cause population decline, but the effects of severe famine can have sharp negative effects on fertility, especially in the short run. The disruption of familial and social life by warfare or migrational patterns separating spouses is also consequential. Longer run negative effects on fertility can result from endemic venereal disease.[11]

The usual methods of demography permit us to calculate reasonably simply the expected number of various kinds of kin under any interesting combination of fertility, mortality, and nuptiality rates. But the results of such calculations describe kinship universes only under what demographers call conditions of stability—that is, conditions under which the underlying demographic rates of fertility, mortality, and nuptiality are not themselves changing, so that even if population *size* is changing, it is changing at a rate of growth that is itself constant. The analogy is an investment at a fixed rate of compound interest. The results of such calculations are heuristic but leave something to be desired. Historians dealing with the scraps of the

[9] For example, in the traditional Serbian terminology, the term for brother's son (*sinovac*) is a derivative of the term for son (*sin*); both of these kinsmen are co-resident and junior to the senior males. Both the daughter's husband and the sister's husband are called *zet;* both are males who take women from the household. Both the mother's sister and the father's sister are called *tetka;* both are nonresident collateral female kin in the parental generation, while the aunts related by marriage are differently called (*strina* for the paternal uncle's wife and *ujna* for the maternal uncle's wife). These patterns are very different from the bilaterally organized terminologies more common in Mediterranean Europe. For details see E. A. Hammel, "Serbo-Croatian Kinship Terminology. With an Appendix on Albanian Terms," *Papers of the Kroeber Anthropological Society* 16 (1957), 45–75, and *Alternative Social Structures and Ritual Relations in the Balkans* (Englewood Cliffs, 1968); for contrasting styles of analysis see E. A. Hammel, "An Algorithm for Crow-Omaha Solutions," in *Formal Semantic Analysis,* ed. E. A. Hammel, special issue of the *American Anthropologist* 67:5:2, (1965), 118–26; Floyd Lounsbury, "The Formal Analysis of Crow- and Omaha-Type Kinship Terminologies," in *Explorations in Cultural Anthropology,* ed. Ward Goodenough (New York, 1964), 351–94; Edmund Leach, "Concerning Trobriand Clans and the Kinship Category Tabu," in *Cambridge Papers in Social Anthropology* 1 (1962), 120–45, ed. J. R. Goody. On the Indian evidence see A. M. Shah, *The Household Dimension of the Family in India* (Berkeley, 1974).

[10] Joel M. Halpern and David Anderson, "The Zadruga: A Century of Change," *Anthropologica* 12 (1970), 83–97.

[11] The Mongol population of China before the public health efforts of the People's Republic, much of modern Central Africa, and the !Kung San peoples of the African Kalahari are examples.

past usually deal with village-sized populations. Such villages are samples from a larger universe, and sampling error itself makes it unlikely that the particular combination of rates manifest in a village over time is stable, even if the larger regional population is stable. Further, it is unlikely that the accidents of history provide stable rates even at the regional or anything short of the global level. The analogy to what we seek is an investment at a fluctuating rate of compound interest. Although standard demographic methods help us to think about demography and kinship, they do not help us as much as we would like—particularly in the Balkans, where stability of any kind seems rare indeed.

The Utility of Computer Simulation

Our salvation from this difficulty is provided literally by a *deus ex machina*. The modern computer, with its ability to perform millions of calculations at great speed, can simulate the processes of demography that otherwise require months, years, and even centuries to display the patterns of events. The idea is simple, and I will go into no technical detail but simply give the basic recipe.[12]

Construct a population of electronic persons, each with electronic characteristics of sex, age, and any other attributes of interest. Put this into a computer. Also put into the computer the schedules of demographic rates that will affect this population, that is, the demographic risks of birth, death, and marriage to which the individuals in the population are continuously subject. Then, using an electronic coin, look at each individual at every successive instant in time and flip the coin to see which, if any, event will occur to that person. Similarly, using some reasonable algorithm for the assemblage of persons into households, form and dissolve such households. At any point in the exercise, take a census of the population. Examine the genealogical structure of the population, and count and classify the households.

Two conclusions emerge from such an exercise. The first is, as expected from demographic theory, that if the demographic rates do not change over time, the age structure of the population will converge toward a stable state; any combination of stable demographic rates has a consequent stable age structure, with particular proportions of the population at each age. For example, a population in which births in each year are almost exactly balanced by deaths, and in which scarcely anyone dies before an advanced age, will ultimately have about equal proportions of persons at every age—a columnar age structure now approached by countries such as Sweden and West Germany. On the other hand, a population in which births in a year greatly exceed deaths will grow at a great rate and will have many more persons at younger than at older ages—a broad-based pyramidal structure like that of countries such as Kenya. The *genealogical* structure of a population is a function of its *age* structure. That is, if we imagined a population in which all persons always married at the same age, and all children were born at the same intervals, the genealogical structure of the population would be isomorphic with the age structure. But all persons do not marry at the same age, and all children are not born at the same intervals. It is well known from common experience that relatives of some degree, let us say first cousins, can be of very different ages even if in the same genealogical generation, that nephews can be older than their uncles and so on. But these factors can be taken into account by appropriate mathematical techniques, so that the genealogical structure is still a function of the age structure. Thus, if the age structure converges toward a stable form, the genealogical structure will also converge toward a stable form. This structure in the *simulated* population will be exactly that of a population estimated by *analytic* methods, if the simulated population is large enough. Thus we can be confident that computer simulation of the process does not violate what other mathematical and demographic theory leads us to expect.

The advantage of simulation is that it permits us to abandon the assumption of stability that is the

[12] The techniques of demographic-sociological microsimulation used in this exercise are discussed in several substantive works: Kenneth Wachter, E. A. Hammel, and Peter Laslett, *Statistical Studies of Historical Social Structure* (New York, 1978); E. A. Hammel, "Experimental History," *Journal of Anthropological Research* 35 (1979), 274–91; E. A. Hammel, K. Wachter, and C. K. McDaniel, "The Kin of the Aged in 2000 A.D," in *Aging: Vol. 2, Social Change,* (ed. James Morgan, Valerie Oppenheimer, and Sara Kiesler (New York, 1981), 11–39; E. A. Hammel, K. Wachter, C. Mason, F. Wang, and H. Yang, "Rapid Population Change and Kinship. The Effects of Unstable Demographic Changes on Chinese Kinship Networks, 1750–2250," in *Effects of Rapid Population Growth,* ed. G. Tapinos, (New York, in press).

Technical documentation of the basic methods is provided in E. A. Hammel, D. Hutchinson, K. Wachter, R. Lundy, and R. Deuel, *SOCSIM: A Demographic-Social Microsimulation Program,* Research Monograph 27 (Berkeley, 1977). The simulations for this paper were based on a Pascal reworking of the original SOCSIM code by C. K. McDaniel, and on extensive reprogramming and implementation, especially of the fertility, nuptiality, and household algorithms, by Carl Mason. Mr. Mason and I are indebted to K. W. Wachter for statistical advice.

sine qua non of the standard demographic methods. We can change the demographic rates as often as our interest dictates. Our electronic village can be as demographically Balkanized as we wish. We can, in fact, examine what genealogical structure would look like in a population just subjected to demographic shock—an epidemic, a return of husbands from the war, or what you will. This is, in fact, the central theme of this paper: what are the effects of unstable demographic conditions on household formation, in the context of a particular set of cultural expectations?

We must be cautious about the phrasing of our intent. Our intent is not to show what real events or conditions were in the real village that we simulate in the machine. There are too many conditions of which we are unaware to permit us to simulate reality. We probably have no record that one Bojan Dragutinović was killed on Kosovo Polje in 1389, that the infant daughter of a Milica Popović fell down a well and was drowned that spring, or that a rake named Marko Marković ran off with his wife's sister in the year after. Neither do we know that the plague came to a place called Gornja Kamenica in 1402. Indeed, even if we took the recorded population of some Bistre Vode with all of its perfectly known characteristics in 1322, and even if we knew to perfection the governing demographic rates to which it was subject,and put all this in the computer, the chances are as close to 100 percent as you can get that the first event in the simulation would not be the same as the first event that happened next in Bistre Vode. Randomness does not lead to replication in single cases, whether it be the randomness of history or that of statistical simulation.

Instead, our intent must be to glean knowledge of a range of outcomes, to detect a pattern to which real populations might be expected to approximate if we looked at enough of them. And so, our technique is simple, if not exciting. We take a population of electronic persons and a set of plausible rates. We subject the population to these rates for a long enough time to achieve a stable structure as a known starting point. Indeed, for purposes of simplicity we specify that this initial population not only be stable, with unchanging rates, but also stationary, with unchanging size. Then we change the rates and subject the population to them for enough time to produce the kinds of kinship linkages and household structures we want to examine. We carry out this exercise independently a number of times and aggregate the results. Our question then is, what happens to a population of some stable structure when it is subjected to a particular kind of demographic shock? The answer to such a question may help us to interpret historically observed household structures when we know what kinds of demographic shocks occurred, or it may help us to think about unobserved demographic shocks and seek other evidence for them, if household structures make it plausible that some such shocks may have occurred.

Demographic Specifications for the Simulations

The exercise I present here is necessarily selective and schematic. I contrast populations characterized by a level of mortality that is plausible for the European late Middle Ages or the Mediterranean basin, based on examination of the work of J. C. Russell[13] and of G. Acsádi and J. Nemeskéri,[14] and following the explorations of Byzantine demography and household structure by Laiou.[15] From examination of this historical evidence, I select a well-understood model mortality table such as is commonly used by demographers, with a pattern of mortality that looks reasonably close to the historical materials examined. This model schedule is, in the terminology of the Coale-Demeny scheme, Model West Level 3.[16] It has an expectation of life at birth for females of 25 years. Please note that an expectation of life at birth of 25 years does not mean that everyone is dead by age 25 or that few people live to be much older than that. Some people may live to be 90, although obviously fewer than if the expectation of life at birth were about 75, as it is in Scandinavia today. At Level 3 mortality, about 30 percent of female infants die in the first year of life, 46 percent are dead by age 5, 41 percent reach reproductive age, and only 24 percent survive to the end of childbearing. Male mortality is somewhat worse than this.

Against the background of this mortality, I use three different fertility schedules in order to in-

[13] J. C. Russell, *Late, Ancient and Mediaeval Populations,* TAPS (Philadelphia, 1958).

[14] G. Acsádi and J. Nemeskéri, *History of Human Lifespan and Mortality* (Budapest, 1970).

[15] *Peasant Society.*

[16] Laiou, *Peasant Society,* uses Model South for the evaluation of data from the core region. Model West may be more appropriate for the more continental climate of the interior of the Balkans. In any case, the differences between the models are small, lying mostly in the slightly lower mortality at age 0 and slightly higher mortality at ages 1–9 for Model South. Survivorship to the middle of the reproductive range is about the same in both.

duce the population change that permits us to measure the effects of instability. One could of course keep fertility constant and change mortality, but population age structures under conditions of severe mortality (as in medieval times) are more sensitive to changes in fertility than they are to changes in mortality.

All three fertility regimes are based on the age-specific *pattern* of marital fertility observed in populations that do not practice contraception designed to limit children to some desired number; that is, they demonstrate so-called "natural fertility." Fertility is nil before age 15 for two reasons: the rates of marriage before age 15 are held to zero, and menarche has a rather late occurrence in premodern populations. After age 15, fertility increases to a peak around age 19, stays at a plateau for a few years, and then begins a gradual decline. The fertility pattern closely mirrors the fecundability pattern, because there is no intentional limitation of births.[17] The *level* of fertility, within this pattern, is selected to achieve three different rates of population growth: zero growth, a decline of half a percent per year, and an increase of one and a half percent per year. The declining and the increasing patterns seem to me to be about at the limits that a population could sustain under these mortality conditions for several generations without being subjected to rather massive pressures of adjustment. A population increasing at 1.5 percent per year doubles every 46 years. A population decreasing at a half a percent per year halves about every 140 years—not as extreme as the increasing case, but involving serious social adjustment, with on average less than one surviving son and daughter per family.

Perhaps the most difficult demographic choices for the modeling exercise were those of nuptiality. Early census materials or even archaeological data may give us some indication of mortality levels. Reasonable fertility patterns and levels can be selected from historical and modern evidence. But evidence on nuptiality patterns in the past is rare and often misleading. Literary history often convinces us that age at marriage in medieval times was very early; yet where reliable documentary evidence is available, the impression is cast in doubt. Some kinds of intriguing evidence, such as that from tombstones, can be statistically quite biased. For this exercise, I rely on theoretical model nuptiality tables, the shape of which by age seems rather constant across human populations,[18] and for the onset of marriage and ultimate proportions marrying I rely on late nineteenth- and early twentieth-century Balkan censuses, which provide the earliest reliable data available.[19]

Cultural Specifications for the Simulations

These demographic forces are intended to play against a set of cultural expectations, or rules, of household formation and dissolution. Even within the general set of expectations provided by the evidence from history, linguistics, and ethnography for patrilocal joint family household formation, one must create specific decision rules, in an algorithm that can be followed during the simulation. The rules are these:

1. Persons may not marry within the same household, nor may they marry anyone with whom they share a common grandparent. Such incest taboo could be more extensive, but these are deemed sufficient for the exercise.
2. Single women can marry men from one year younger to 10 years older. Single men can marry women from 10 years younger to 10 years older. Widows can marry men from 10 years younger to 10 years older. Widowers can marry women from 10 years younger to one year older.
3. Widows do not remarry if their current household contains at least one male aged between 15 and 50, or if they are over age 45. Widowers do not remarry if they are over age 60. Otherwise both widows and widowers are immediately eligible for remarriage and tend to remarry soon.
4. Ordinarily, when a man marries, he remains in his parents' household, and his bride joins him. However, if the bride has no co-resident brothers, she cannot leave it. Her husband

[17] Demographers distinguish fertility (as the achieved number of births) from fecundity (the capacity to bring a conception to term) and sometimes from fecundability (the capacity to conceive). This is the English usage. In the French usage, *fecondité* is the number of births and *fertilité* the capacity to bring a conception to term (or sometimes to conceive).

[18] A. J. Coale and D. R. McNeil, "The Distribution by Age of the Frequency of First Marriage in a Female Cohort," *Journal of the American Statistical Association* 67 (1972), 743–49.

[19] Nikolai Botev, "Nuptiality in the Course of the Demographic Transition: The Experience of the Balkan Countries," *Population Studies* (in press).

may join her, if he is not the sole surviving son of his parents in their household. If he is, under these circumstances, the marriage may not take place. These rules implement the general expectation of patrivirilocal postmarital residence but allow for the alternative of adoptive son-in-law residence, known in Serbo-Croatian as *domazetstvo*.

5. When a man marries, if he is co-resident with a grandparent, he must leave the household. This rule does not apply if the man is an adoptive son-in-law co-resident with his wife's grandparent. This rule provides for the fission of the usual patrivirilocal households. Ethnographic experience shows that although lineages may continue to expand their scope to a wider range, households do not maintain co-residence and economic corporacy indefinitely, but break up.
6. If a woman remarries, she and her husband follow the same rules of postmarital residence that apply for first marriages. Children under the age of 15 follow their surviving parent on remarriage, while older or married children remain in their current household. Step children do not follow step parents.

These rules reflect fairly well the kinds of processes that seem, from the evidence of informant testimony, to govern household cycles in the traditional Slavic and Albanian Balkans. They do not admit of exceptions to the general rule of patrivirilocal residence that is the stated norm. On the other hand, they do not permit the growth of the extremely large households that are often held forth as the ideal. The selection of the dissolution rule is judgmental; in my view, the achievement of very large households is possible only under conditions of settled and advanced agriculture. These would not have been met in most of the Slavic and Albanian fringe, where pastoralism was the rule, and even in the core of the Nemanjid lands, administrative pressures to break up households, so as to prevent minimization of the hearth tax or other feudal dues, would have militated against the growth of very large units.[20] The ideal rule for household formation may be too generous. The seemingly restrictive rule for dissolution may also be too generous. It may well be that in real life the rule for inclusion was followed less often than demographic circumstance permitted, and that dissolution came sooner than the ideal would have dictated.

Conduct of the Simulations

The first step in analysis was to create 10 independent populations of about 2,000 persons each, with a stable age and kinship structure appropriate to a scenario of no change in population size. These populations are simulated under the scenario of no change for 90 years, starting at a year I call −90.

At Year 0 household censuses are taken, and then fertility rates are changed to achieve either the increasing or decreasing growth regime. The simulation proceeds, and household censuses are again taken at Years 30, 60, 90, and 140, thus approximately at the generation changes for three generations and a final point at which stability is being approached more closely. (No further simulation beyond Year 0 is conducted at the zero growth rate, because the prior phase of the simulation has already provided evidence on population and household structure after 90 years of zero growth, and under zero growth, no fluctuations are expected at intermediate points.) In Year 30 some kinship relationships will have been dictated entirely by the new fertility rates. For example, the number of living married sons for men married at or after Year 0 can only have been affected by the new fertility rates, since almost all men who will ever marry will have married by age 30 and thus will have been born in the last 30 years, since the new rates were invoked. Others will have been dictated almost entirely by the previous fertility rates, for example, the number of living married second cousins, because most of the demographic events (other than death) leading to that relationship will have occurred before Year 0. As the simulation moves toward Year 90, more and more of the relationships will come to be produced by events occurring under the new demographic regime and less by those occurring under the old, so that the new regime comes to dominate the genealogical structure. By Year 90, even the relationship between second cousins will have resulted from events occurring only under the new demographic rates. The age structure of the population is *not yet* a stable one; the echoing ripples of the rate change

[20] See Hammel, "The Zadruga as Process," 365 note 46, for references to such pressures in the Code of Stefan Dušan, the chrysobulls of Bistrica and Sveti Stefan, and a Turkish *ferman* as late as 1766.

shock at Year 0 will continue to reverberate down through time, but diminishing. By Year 140 the structure is moving closer to stability, and by Year 200 the shock waves will no longer be easily detectable.

However, our interest is not in stability but in instability. The simulation started with a stable population simply to have a known starting point, and our rates of growth would not be sustainable long enough to reach stability. At the increasing rates, the population would be about 20 times larger at the end of two centuries; a village of 500 grown to 10,000 is a city and very different. At the decreasing rates, the population would be about a third of its original size, 180 in this example, well on its way to becoming a hamlet with a broken well sweep.

Construction of the infrastructure of kinship relationships is not the only process occurring. An additional process is the recruitment of persons into household units, according to some cultural rule. Since, for simplicity, that rule has been held constant (although it is complex), the formation of households must be a direct reflection of the kinship changes, and thus of the demographic changes. But there is also a countervailing process, that of the dissolution of households. The "cultural" prescriptions for dissolution are also held constant, but in some degree such dissolution is also demographically caused—for example, changes from multiple lineal households (where two conjugal units, one of which is the lineal descendant of the other, co-reside) to extended lineal households (where one conjugal unit co-resides with a widowed lineal ascendant) when one of a pair of elderly parents dies. But in another degree such dissolution is sociological or cultural—for example, the division of a multiple lineal household into its varied segments if grandsons marry while the grandfather is still alive (under the dissolution rule adopted here). Similarly, we may expect the desired nuptiality rates to be achieved only approximately. If populations become small through negative growth, it may not always be possible for marriageable persons to find one another (even in that epitome of a computerized dating service, a demographic/sociological microsimulation program), thus prolonging the length of the cycle of household formation, allowing for changes through deaths in the interim. For example, a household in which a son might marry so as to create a unit with two conjugal pairs—the parental and the filial—might have difficulty finding a wife, and his father might die in the interim, so that when the son did marry, the household would consist of one conjugal unit plus a widowed mother, not two lineally related conjugal pairs.

Rules of Household Classification

Let me now briefly review the way households will be classified for this exercise.[21] The scheme focuses on the conjugal pair as the key unit, and on combinations of conjugal pairs and non-conjugal addition to such pairs. A conjugal unit consists of a married pair, or of one member of a married pair (the other being deceased) and unmarried children of that or a prior marriage. Headship of households is attributed to the senior surviving conjugal unit therein. Where a household contains more than one conjugal pair, it is called Multiple. Where a household contains a non-conjugal addition, it is called Extended. Both multiplicity and extension are subclassified by whether the additions are Lineal (ascendant-descendant) or Lateral, and whether the addition is in an ascending or descending generation. Households with a conjugal unit but no additions are called Nuclear. Households with more than one inhabitant but no conjugal units are called Special. Households with only one inhabitant are called Sole. It follows from this that households that are Nuclear, Sole, or Special cannot be simultaneously classified as anything else, but that other kinds of households can be classified simultaneously in different ways.

Consider the following examples:

Sole (S):
: One person alone.

Special (SPEC):
: Two or more persons but no conjugal unit.

Nuclear (N):
: Husband, wife, and/or unmarried children. (One conjugal unit only.)

Multiple Lineal (MLN):
: Husband, wife, unmarried children, and at least one married child with spouse and/or unmarried children. (Two or more conjugal units lineally related.)

Multiple Lateral (MLT):
: Two brothers with their wives and unmar-

[21] Hammel and Laslett, op. cit. Hammel and Deuel, *Five Classy Programs: Computer Programs for the Classification of Households*, Research Monograph 33 (Berkeley, 1977). The category "Other" is omitted here, since the household formation rules do not admit of nonkinship inclusions.

ried children. (Two or more conjugal units laterally related at the same generation level.)

Extended Lineal (XLN):
: Married son with wife and/or unmarried children and a widowed parent with no remaining unmarried children. (One complete and one remnant conjugal unit lineally related.)

Extended Lateral (XLT):
: Married brother with wife and/or unmarried children and at least one unmarried or widowed sibling. (One complete and one preconjugal or remnant conjugal unit laterally related at the same generation level.)

Multiple Lateral Down (MLTD):
: Married uncle with wife and/or unmarried child and at least one married nephew with spouse and/or unmarried children. (Two conjugal units laterally related but in different generations.)

Extended Lateral Down (XLTD):
: Married uncle with wife and/or unmarried child and at least one unmarried nephew or niece. (One complete conjugal unit and at least one preconjugal or remnant conjugal unit laterally related but in different generations.)

MLT + XLN + MLTD + XLTD:
: Two married brothers with wives and children, a widowed mother, a married nephew with wife and children who is the son of a third brother and his wife who are deceased, and an unmarried niece who is the daughter of a fourth brother and his wife who are deceased.

Other complex examples can be constructed.

Demographic Results of the Simulations

Table 1 provides statistical information on the demographic aspects of the simulations for the two growth scenarios. Columns 1 and 2 give average population size at Years 0 and 140. Column 3 gives the average achieved rate of growth over the time span. Column 4 gives the target Total Fertility Rate (TFR) in the simulations.[22] Columns 5 and 6 give the target age at first marriage for women and proportion of women married by age 25. Population statistics were taken at only one point under zero growth, since the age structure had stabilized because nothing was changing. Population size decreases under negative growth and increases under positive growth at the levels and rates given. The total fertility rates are ethnographically and demographically reasonable; the TFR under the positive growth regime is very close to the maximum anticipated for human populations under ordinary circumstances.[23]

Household Structures in the Simulations

The data generated by the simulations are enormously complex. There are 7 different basic kinds of households, and 5 of these can occur in combinations with one another in almost any number. A full presentation of the variety of achieved household classifications would be bewildering and beyond the scope of this paper. Therefore, I focus on the main points.

Table 2 summarizes, for each growth scenario and for Years 0, 30, 60, and 140, the numbers of persons, numbers of households, average number of conjugal units per household, average number of non-conjugal extensions per household, average size of households, and, as an overall measure of complexity, the average number of classifications applied to households.[24] As before, data are given only for Year 0 for the zero growth scenario. The general trends of decrease or increase in the population of persons and in the number of households are clear. The number of conjugal nuclei per household is just under 2 at zero growth,

[22] The TFR is a common measure of population fertility. It is the number of children a woman could expect to bear if she lived from age 15 to 49. It is affected not only by the level of fertility in marriage but by the level of illegitimate fertility and the rates of nuptiality and remarriage. In these simulations, all fertility is within marriage. Virtually all women marry and at a relatively early age. Widows remarry very rapidly if they are less than age 35. Thus the TFR here is close to the average experience of surviving married women.

[23] The achieved figures are not exactly those that might have been anticipated from the input specifications; exact achievement of input rates requires simulation of very much larger populations and/or many more simulation experiments, and can be approached in the limit. Some achieved rates, especially of nuptiality and fertility, are virtually never the same as the intended growth rates, regardless of population size or number of simulations, because of the complex interactions of fertility and nuptiality and delays in the marriage market that remove women from the risk of childbearing. The target growth rates had been +2 percent and −0.5 percent. For technical reasons I am unable to report the precise achieved BAFM and proportion married by age 25 in Table 1.

[24] Classifications Sole, Special, and Nuclear count for zero complexity.

TABLE 1

Demographic Rates

Growth Level	P(0)	P(140)	Growth Rate	TFR	BAFM	Mar @25
Zero	20377	20377	0.0	7.658	18.189	98.368
Negative	20377	10859	−0.004	6.344	18.189	98.368
Positive	20377	129864	0.013	12.278	18.189	98.368

P(0) and P(140) are average sizes at Years 0 and 140. Growth Rate is the crude annual rate of growth. TFR is the Total Fertility Rate. BAFM is the target for bride's age at first marriage. Mar@25 is the target proportion of women married by age 25.

reflecting the expectation of fairly stable stem family household organization with about two children and thus one co-resident married child per parental conjugal nucleus. This number decreases under a regime of population decline and increases under a regime of expansion, so that after 140 years of decline only about every fifth household achieves stem family organization, while after 140 years of increase there are on average 6 conjugal pairs per household.

Non-conjugal extensions to the household average just under 2 at zero growth. They then increase as population growth declines and hold fairly steady from Year 30 to 140. This is an unanticipated result, but the mechanisms are clear. As the stock of available children and siblings to form additional nuclei declines, the opportunity to form multinuclear households decreases. But the growth rate is only slightly negative, so that many families do have at least one child who may be expected under the marriage rules to co-reside. Whenever a parent dies, and that would be fairly soon under the severe mortality schedule, the binuclearity of the household is transformed into a nucleus plus an extension. Thus extensions continue to be added at about the same rate per household, while nuclei are not so added, and the number of households shrinks as population declines.

Household size, of course, reflects these underlying organizational trends. It is about 8 at zero growth, very much in line with the average of about two nuclei per household and the expectation of about two children per conjugal unit. The number of nonzero classificatory principles applied at least once per household, which gives an approximate index of household complexity, is just under 2 at zero growth. It increases slightly at Year 30 under the regime of decline, perhaps reflecting the same decay of multi-unit households into units with non-conjugal extensions.[25] Under further negative growth, households become steadily simpler, while under positive growth they become increasingly complex. However, at Year 140 of the positive growth regime, complexity declines. I defer discussion of the complexity measure and this curious result to the paragraph below, in which I interpret the graphic presentation of these and other data.

While the overall trends shown in Table 2 are reasonably clear, they mask some interesting complexities. These are summarized and presented graphically in Figures 1–4. Figure 1 presents the measure of overall complexity of households defined for Table 2. The lowest such numbers are generated by types Nuclear, Sole, and Special, all of which are either nuclear households or their remnants after the death of one or both parents, since such households can present only one classificatory type and do not co-occur with other types. Complex households are combinations of the other types. Figure 1 shows these averages at 5 time points: Years 0, 30, 60, 90, and 140. The upper half of the figure shows the situation for the scenario of positive growth, the lower half for the scenario of negative growth.

Let us first examine the upper half, for positive growth. It shows that the average complexity of households increases steadily for 90 years, as we might expect. Then, however, it falls in Year 140 to the level shown for about Year 60. By Year 140 the population age structure, thus the kinship structure, and one would also think the household structure, should be approaching stability. Why

[25] The research is not yet sufficiently advanced to have produced the microsimulation-based sampling distributions on the basis of which judgments about the statistical significance of differences might be made.

TABLE 2

Household Characteristics

Growth/Year	P	N(HH)	M/N(HH)	X/N(HH)	P/N(HH)	Class/ N(HH)
Zero	20377	2436	1.979	1.848	8.365	1.892
Neg @ 30	19894	2506	1.862	2.325	7.939	1.904
Neg @ 60	17667	2426	1.579	2.505	7.282	1.645
Neg @ 90	14743	2200	1.358	2.533	6.701	1.437
Neg @ 140	10859	1745	1.233	2.448	6.223	1.270
Pos @ 30	29440	2474	2.433	2.650	11.900	2.329
Pos @ 60	43677	2585	3.547	2.950	16.896	2.736
Pos @ 90	65061	2949	4.723	3.281	22.062	2.869
Pos @ 140	129864	4672	6.114	3.327	27.796	2.430

Growth/Year indicates the level of growth and the year of observation. Only one observation was taken at level zero. P is the average population size. N(HH) is the average number of households. M/N(HH) is the average number of conjugal nuclei per household. X/N(HH) is the average number of non-conjugal extensions ot nuclei per household. P/N(HH) is the average household size. Class/N(HH) is the average number of non-zero classificatory principles applied at least once, per household, as a measure of overall complexity.

should the average complexity of households decline?

We must take into account the rule of dissolution based on the "grandparent" limit. Suppose a population at zero growth, with on average one son per conjugal pair. If, on marriage, a man had co-resided with his grandfather, he would leave to form a nuclear household, with his grandfather and father remaining behind in a complex household (presuming the survivorship of the father). His original household would have been an MLN or XLN household; had he remained in it, the classification would not have changed. When he leaves it, the classification still would not change. On the other hand, if the average number of children per household had been higher (say, 4, with two sons per household), and two brothers married, their household would have been MLN or XLN and also MLT, with more complexities than under zero growth. If they left, the household would be reduced in complexity, losing its MLT classification. In the second generation of an enhanced growth scenario, two brothers would have a total of 4 sons, with the possibility of more complexities, such as MLTD, and in the third generation there might be 4 co-resident brothers with 8 sons, further enhancing the possibility of such complexity. But any household may come up against the "grandparent" limit. The longer the household has survived under positive growth, the more complex it will be, and the more drastic will be the reduction in its complexity when it reaches the "grandparent" limit. Thus households reach a peak of complexity after about three generations under positive growth (since this of course is the extent of the "grandparent" boundary), and then settle down toward an equilibrium that is constrained by the dissolution rule. Note that when a complex household divides into some number of nuclear households, the number of households forming the denominator of the complexity index is increased, while the number of complex households decreases. Both of these events lower the complexity index. The larger the number of nuclei in the complex household, the greater is this effect.

Under negative growth, the pattern seems less problematical, a steady decrease in complexity as declining numbers of persons provide less and less raw material for the formation of complex households. But as already noted, there might be a slight increase in complexity by Year 30. This may be a statistical fluke, but it may also result from a deceleration in household fission, since with fewer sons per family, households are propelled less rapidly toward the "grandparent" limit.

Figure 2 looks more deeply at the distribution of kinds of complexity. The general structure of the figure is the same as in Figure 1, but here the dif-

ferently hatched segments of each column indicate the proportion of households, at each census year, that have no complexity, one complexity, two, . . . up to 6 complexities. Under positive growth, the proportion of households with the highest level of complexity increases over time, holding steady between Year 90 and 140. The proportion with no complexity decreases for 60 years. Between 60 and 140 years, although the proportion with the highest complexity holds about steady, the proportion with zero complexity increases. The reason for this increase at level zero complexity is just as elucidated above. Many households are coming up against the "grandparent" limit. Most of these seem to be in the range 2–5 complexities, since they tend to diminish. With the exception of the reversal between Years 60 and 140, most of the process seems to be a packing of households from levels of lower complexity up into levels of higher complexity, and the reversal may be attributed to the enhanced effect of the dissolution rule as more and more households come against that boundary.

The situation under the declining scenario in the lower half of Figure 2 is generally straightforward. There is a slight increase between Years 0 and 30 at the highest level of complexity, as noted in discussion of Table 2; otherwise the trend is downward, with higher complexities being packed into lower complexities over time.

While it would be impossible to follow these patterns through all of the kinds and combinations of kinds of household classifications, we can focus on two of the most interesting types—the classic forms of the patrivirilocal joint family, MLN and MLT, the former with father and married sons, the latter with married brothers. Figure 3 shows the levels of complexity achieved by all households to which the MLN classification was applied, as a percent of all households. Under positive growth, the proportion MLN increases for 90 years, then falls off at Year 140, because of the operation of the dissolution rule, as already noted. The level of additional complexities goes up steadily to Year 140. As before, there are complex tradeoffs between the levels of complexity, but in general most of the growth in overall complexity seems attributable to growth at the highest level of complexity. The decline in overall complexity between Years 90 and 140 for MLN households is mostly attributable to a decline in MLN plus 4 other complexities.[26]

[26]Teasing out the paths that lead to these results requires a different analysis, one of the actual longitudinal cycle of development of households. That is not undertaken here.

The situation under negative growth is straightforward, a steady decline in proportion MLN. The most consistent changes appear for the most complex households at MLN plus 4 or 5 other complexities.

Figure 4 shows the same kind of display for MLT households. The picture is very similar to Figure 3 under positive growth, but the downturn at Year 140 is sharper. This is because the stock of brothers that might have formed an MLT household if a grandparent were present is more severely affected by the dissolution rule when those brothers are in the parental generation, with many sons of their own. Thus a household with four senior males, each with four sons who could marry in the absence of a grandfather to form a single MLN + MLT household would break into 8 households if a grandfather were present. In the previous generation of high growth, only two senior males (the two sons of a family under high growth after one generation) would also form an MLN + MLT household with a total of 4 sons in the absence of a grandfather, but would break into only 6 households. In the previous generation, a single senior male would have two sons in the first generation of high growth, and such a household would break up into 3 households. Thus the longer growth has gone on, and the higher its results have crept in the genealogical hierarchy, the more drastic is the inflation of the number of households on dissolution, the larger is the denominator for the complexity proportion, and the lower is the proportion complex. The situation under the scenario of declining population is, again, straightforward; complexity is regularly reduced.

Discussion

The data produced by the simulations are only a simulacrum of the processes in the real world of family and household. Many important features of social process are ignored. Yet even under conditions of experimental simplicity, the results are extraordinarily complex. In general, we see the results of intuition confirmed. Under conditions of population growth, the relative weight of complex household organization increases, where the cultural prescriptions themselves permit or encourage such complexity. Under conditions of population decline, complexity is diminished, even in the presence of cultural conditions that would favor it.

However, population growth cannot lead to unrestrained complexity, since the cultural rules pro-

Figure 1
Weighted Average of Household Complexity

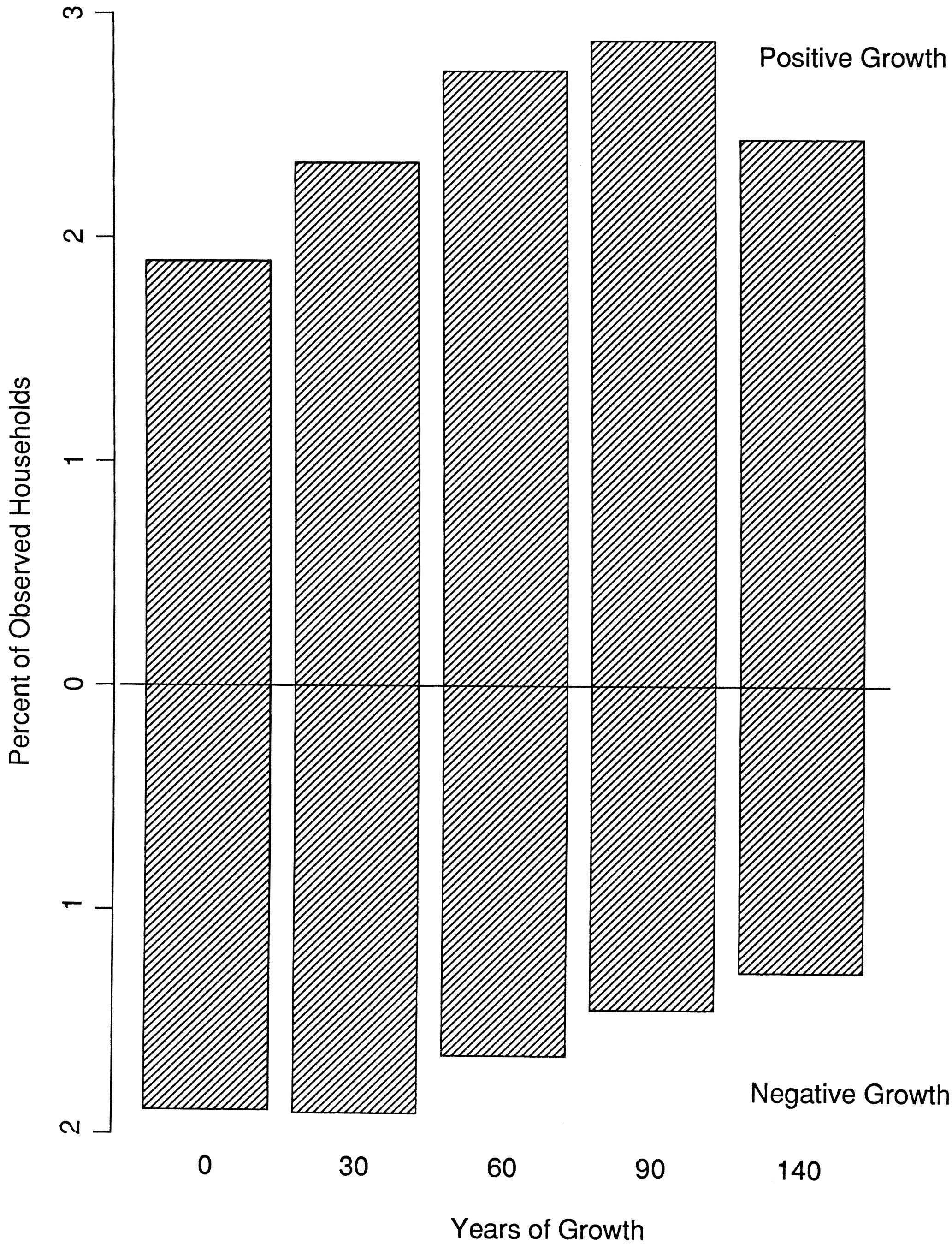


Figure 2
Distribution of Household Complexity

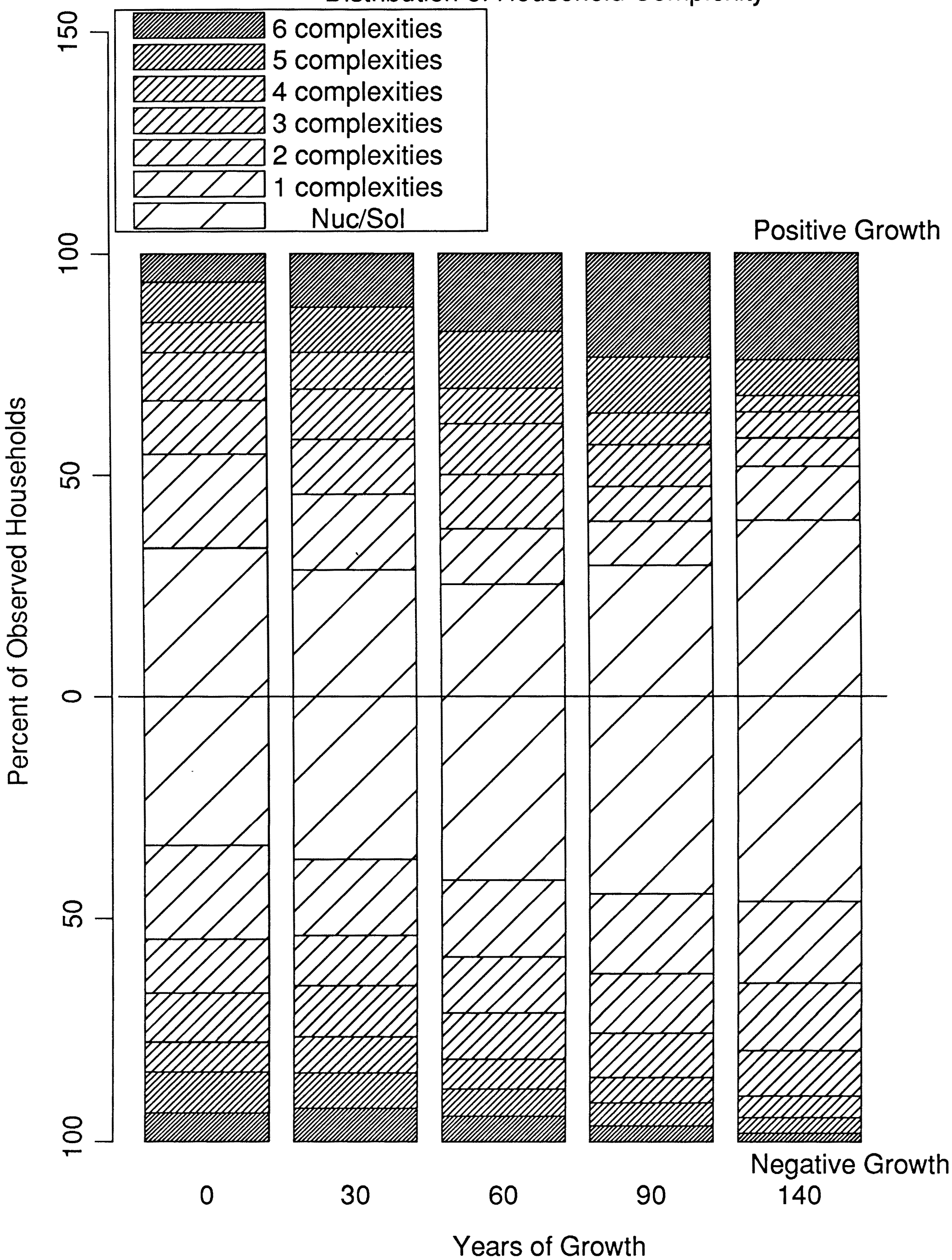


Figure 3
Percent of Multiply Classified MLN Households

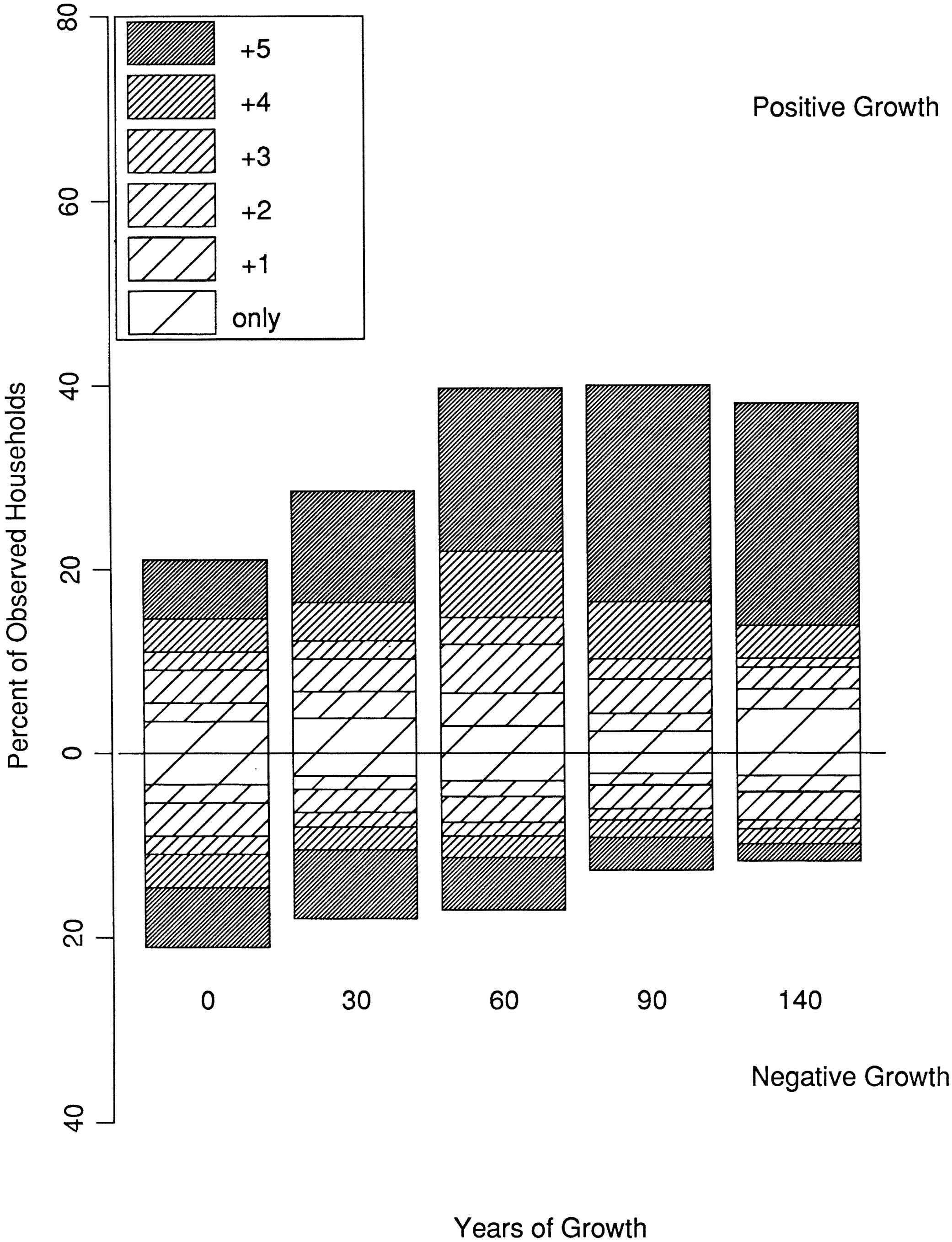
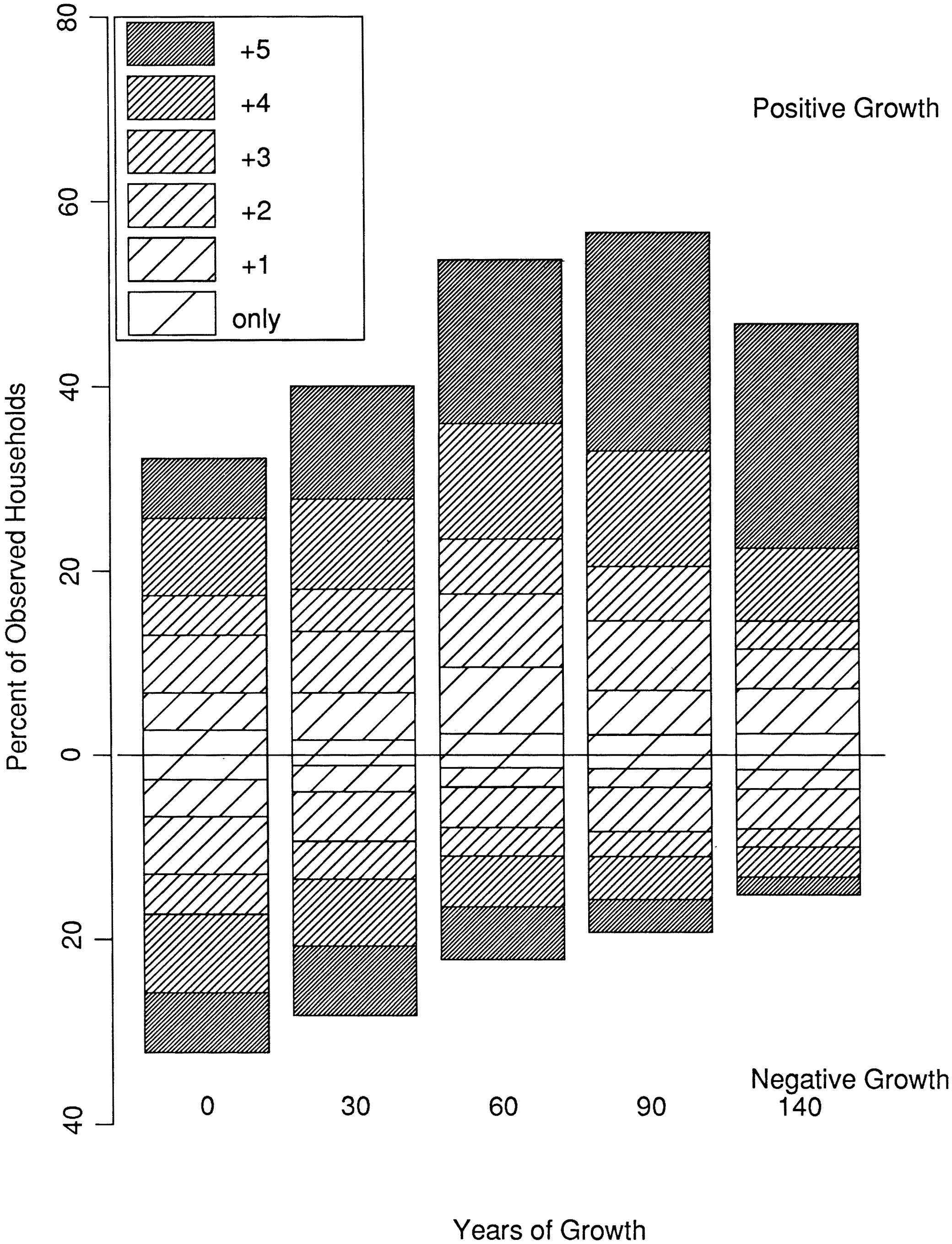


Figure 4
Percent of Multiply Classified MLT Households



vide for the fission of households, as well as for their formation. Moreover, the rule of dissolution introduces some effects that are at first puzzling, and these lead us to speculate how these might influence broader areas of social life. Under conditions of rapid population growth, households are pushed more rapidly toward the permissible boundary of complexity. Further, under conditions of high fertility it is likely that the average age at childbearing is low and that generation lengths are short. Under such conditions it is not only that the level of complexity is raised, but also that the cycle of household development is accelerated. Thus we find that in a rapidly growing population, the cycle of turnover is more rapid, with consequences for more frequent division of property under a joint family system with partible inheritance. This implication was certainly not part of our intuition. Conversely, under conditions of population decline, complexity decreases, since the stock of persons to form complex units decreases, but the cycle of development appears decelerated, with implications for greater stability of family holdings across generations. On average, we would expect the greatest stability of partible inheritance where demography graciously provided stem families, that is, under conditions of zero growth. But if custom allows women without brothers to inherit, as it does in Slavic tradition, parcelization is minimized under conditions of population decline, and in fact the recombination of family estates attendant on the marriage of "only" children leads to engrossment. Generations of capitalistically inclined peasants have of course discovered this without benefit of computer simulation, but it is good to know that they were correct even on the basis of their limited capacity for experimentation.

It is instructive to compare the results of the simulations to empirical observations. An interesting, if simple, feature is the proportion of nuclear households. In these simulations we found about 20 percent of households nuclear under zero or negative growth. Under positive growth the proportion nuclear declines as low as 14 percent by Year 60; it then increases to a startling 32 percent by Year 140, more than the proportion evident under zero growth. This explosive increase by Year 140 is of course a consequence of the numbers of households that were able to reach three-generational depth with co-resident brothers and cousins, and then were broken up by the dissolution rule when the cousins began to marry. Is it possible that family structure has not reached stability even after a century and a half of stable rates?[27]

Data from Slavic populations at the presumed peak of their joint-family tradition show at least 30 percent of households to be nuclear, although a critique of interpretive assumptions indicates a figure between 20 and 50 percent.[28] In presumably Slavic populations suffering what may be acute demographic distress, the figure is much higher, around 80 percent.[29] Laiou's analysis of households in the Theme of Strymon shows about 50 to 60 percent nuclear households.[30] The simulation results are thus in reasonable accord with the empirical data from the core Slavic area. Does that mean that the simulations have "got it right," and that we may conclude we now understand the mortality, fertility, nuptiality, and household formation rules of such populations?

We could perhaps attribute the differences between the simulated Slavic populations and those of Dečani, Sveti Stefan, and the *beogradska nahija* on the one hand, and the empirical ones of Strymon on the other, to differences in cultural tradition—the first operating under Slavic rules, the second under more Mediterranean ones. But even further north of the Theme of Strymon on the Strumitsa, the Slavic properties of Chilandar exhibit nuclearity proportions more like those of Thessalonike, so that the answer cannot lie only in "culture." It is possible that mortality conditions in the Chilandar properties were more severe than those in force either in the Slavic core or in Strymon. Laiou's analysis gives some confidence that the mortality regime selected for Strymon is reasonable, if not even somewhat generous. The Chilandar properties may have been a disaster area.

Thus a possible interpretation of the similarity in level of nuclearity between the simulated populations after 140 years under the growth regime and the empirically observed populations at the peak of Slavic development in the interior is that the simulations have in fact mirrored what was going on on the ground. That is, if the mortality rates are about right, and if the rules of household

[27] Further simulation experiments could be conducted to examine how long it takes for age structures, kinship structures, and household structures to reach stability, but such work goes well beyond the exploratory intent of the present paper.

[28] Hammel, "Sensitivity Analysis," (above, note 3). The main sources here are the chrysobulls of Dečani and of Sveti Stefan and a 16th-century *defter* from the Belgrade *nahija*.

[29] Hammel, "Household Structure in Fourteenth Century Macedonia," (above, note 2).

[30] Laiou, *Peasant Society*, 81.

formation and dissolution as gleaned from ethnography are about right, then the empirical populations seem likely to have been growing at about 1.3 percent per year for a century and a half or more.

I would not be so sanguine. It is possible, as noted, that the rules of household formation and dissolution employed in the simulation were in fact too generous. Even though the evidence from idealized ethnography shows that sons remained typically with their fathers, and brothers stuck together through thick and thin, so that some households reached enormous size and span, there must have been internal pressures or external demands for division that accelerated fission for most households even before the "grandparent" limit was reached.[31] Under that more cynical view we would have to posit a somewhat higher growth rate, thus either lower mortality or higher fertility, to achieve the same structures. If we have confidence in the selection of mortality level, we face a serious constraint in achieving higher growth through heightened fertility, since the fertility levels already come very close to the maximum we might expect in any human population. This is a serious constraint, since the mortality level selected is already close to the worst contained in the standard model life tables and to the extreme of human experience (expectation of life at birth of 18.5 years at Level 1), and mortality differences can be shown to have only a minor effect on kinship structures, compared to fertility differences.

Still, our best hope in trying to reason toward the most likely historical conditions is to seek to find better data on actual mortality conditions. Where *praktika* provide the right kinds of information, we might compare age distributions to model life tables. Where monastery records or even tombstones or the analysis of skeletal materials yield information on age at death, we might (with great caution and exercise of anthropological and demographic criticism) again attempt to fit data to model life tables. While these exercises are difficult, they may help to firm the ground, since it is less likely that historical investigation will yield much in the way of detailed information on rules of household formation and dissolution for the general population, and legal prescriptions (which often are available) have been circumvented by peasants since time immemorial.

[31] One of my favorite comments on fraternal solidarity is contained in the Serbian proverb, "Da je brat dobar, i Bog bi ga imao" ("If brothers were so good, then God would have had one").

Conclusion

This exercise in modeling employs a bit of technology and well understood principles of demography and statistics to move into uncharted seas—the world of demographic instability in which most populations have always lived. We are able to navigate with the charts of demography and the compass of ethnography in a fog of dense ignorance. The procedures of simulation are known to be reliable in approximating the results of well-understood theory, which itself cannot deal with the complexities of instability. Much of what the simulation reveals confirms our intuition about how changes in fertility must affect family formation. Other results deepen that intuition, calling our attention to the complex effects of dissolution processes under changing demographic rates. Further simulations can extend the range of such sensitivity testing, allowing us to tack against this or that wind of presumed conditions. But it lies to the careful work of historians in their assembly and critique of original materials to permit us to sail more closely to better-known winds.

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